A Novel MEMS Reconfigurable Leaky Wave Antenna

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A microstrip leaky wave antenna (LWA) is based on the leakage properties of a microstrip transmission line. The structure can be seen either as a long rectangular patch or as a large open circuited microstrip line. Such an antenna radiates when excited in its first higher order propagating mode and when its dominant transmission line mode is suppressed. It has been shown that it is possible to generate a narrow tilted fan beam in the H plane of a LWA through a single excitation (C.Luxey and J.Laheurte, *IEE Proc. Microwave Ant. & Prop*. vol. 144, No. 6, Dec. 1997). A simple LWA based array for a tilted pencil beam has been proposed for automotive transceiver application (C. Hu et al, *IEEE Trans. Antennas Propagat.* vol. 45, No. 11, Nov. 1997). LWAs as frequency scanned elements have been proposed as an alternative to achieving beam scanning without phase shifters. But the frequency bandwidth available usually limits the scan performance, if wide-angle coverage is required. By periodically loading the radiating edges of a LWA with capacitors and varying the capacitor DC bias, single beam steering at a fixed frequency was demonstrated (C.Luxey and J.Laheurte, *Electron Lett*. vol. 36, No. 15, July. 2000). A 2-beam, scanning LWA integrated with a varactor tuned voltage controlled oscillator was demonstrated where beam steering was achieved by tuning the oscillator frequency with DC bias voltage (C. Wang et al. *IEEE Trans. Antennas Propagat.* vol. 47, No. 8, Aug. 1999).

In this paper, a novel MEMS based 3-beam switchable Leaky Wave Antenna is proposed. The antenna consists of two leaky wave structures placed symmetrically on both sides of a rectangular patch antenna. In this configuration, the center patch provides a broadside beam and the leaky wave structures (with transverse slits to inhibit propagation of the dominant surface wave mode) provide two narrow tilted beams. The antenna beam switching is achieved by reconfiguration of the broadside patch structure into two leaky wave structures. This is accomplished by turning on any of the flexible circuit based MEMS actuator pairs located on either sides of the center patch. Thus the proposed configuration provides a broadside beam when the MEMS actuators are off, and can be reconfigured to provide a tilted beam by turning either the right or the left actuator pairs on through applied DC bias voltage. The antenna has been fabricated on 20 mil thick RT/Duroid 6002 substrate ($\varepsilon_r = 2.94$). The flexible circuit-based MEMS actuators (R. Ramadoss, S. Lee, V.M. Bright, Y. C. Lee, and K. C. Gupta, *IEEE Int. Microwave Symp. Dig.*, June 2-7, 2002) have been designed, fabricated, and integrated with the antenna, at University of Colorado at Boulder in collaboration with NASA Glenn Research Center. Preliminary data on S-parameter (S_{11}) and radiation pattern measurements of the LWA with the MEMS actuators on and off show the validity of the predicted performance. Details of the simulated and experimental results will be presented and discussed.